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Fig. 1.

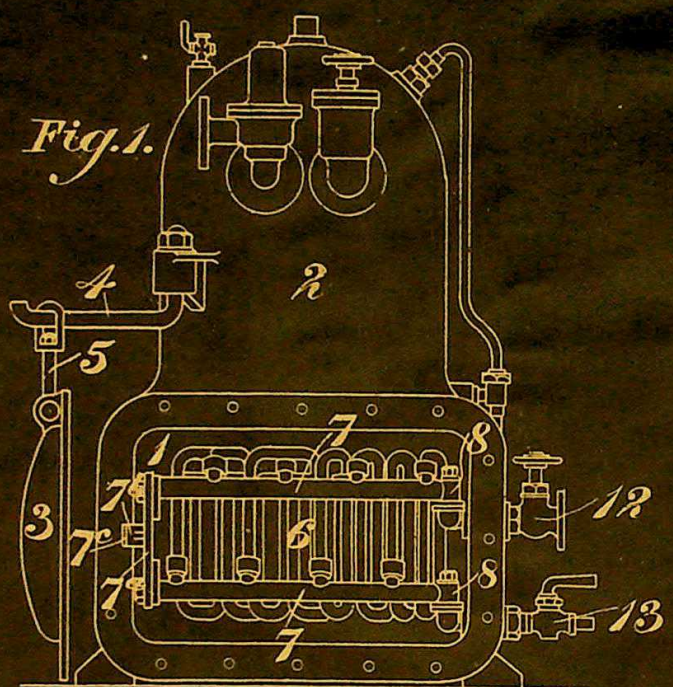

Fig. 2

Fig. 3.

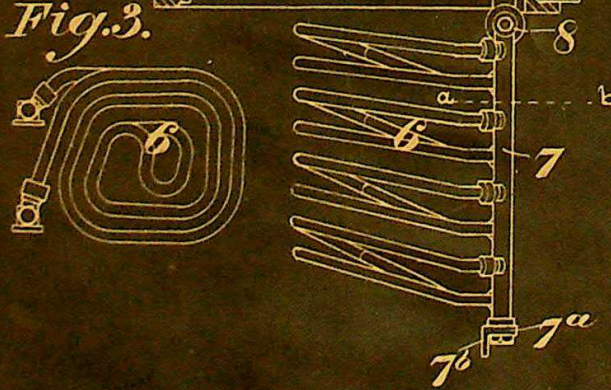

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Fig. 4.

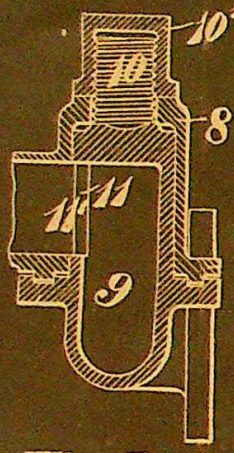


Fig. 5.

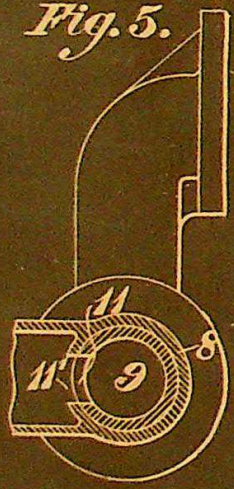
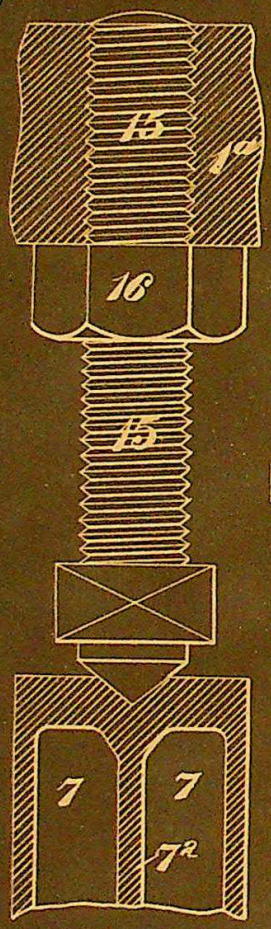


Fig. 19.



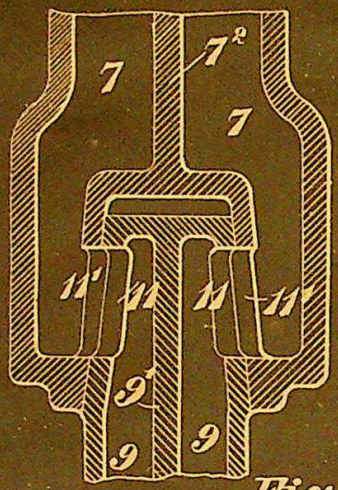


Fig. 17.

Fig. 18.

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Fig. 6.

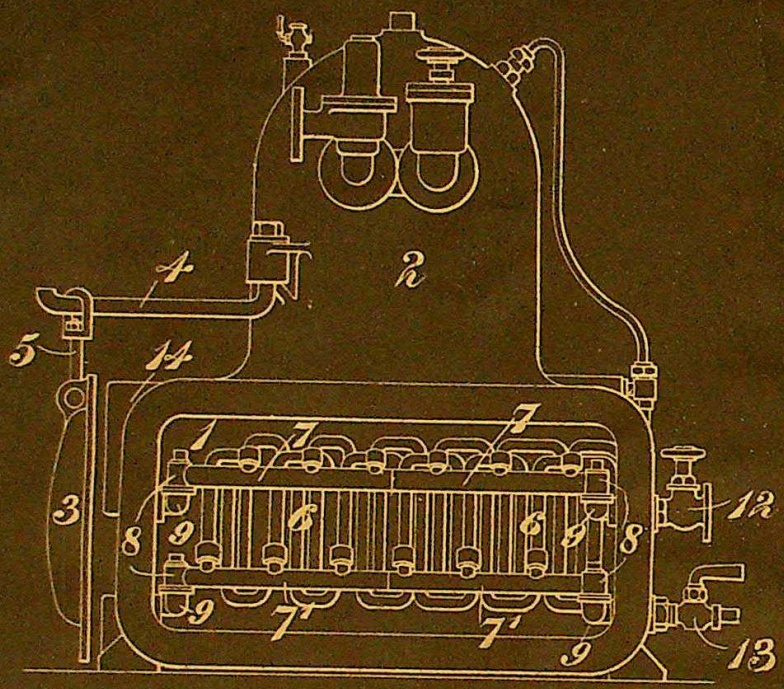


Fig. 7.

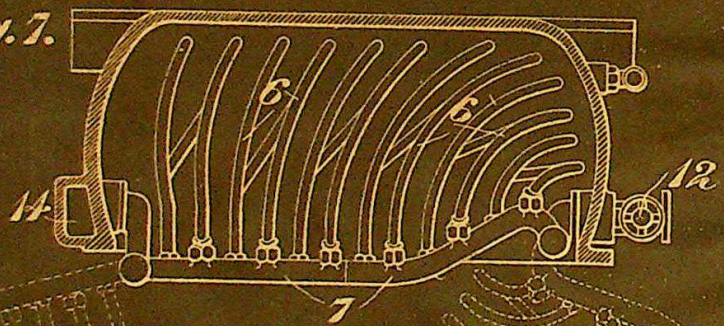
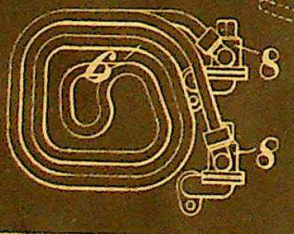


Fig. 8.



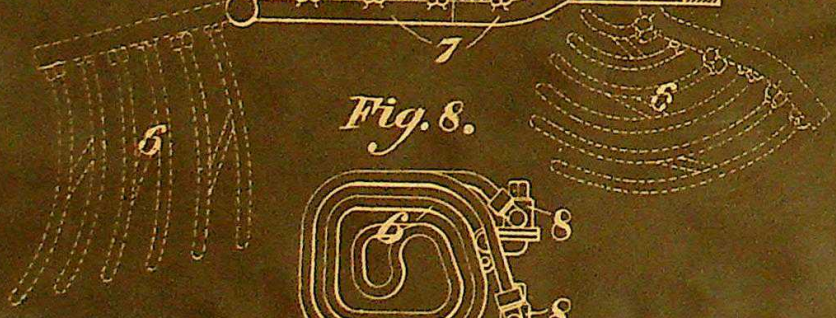


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Fig. 9.

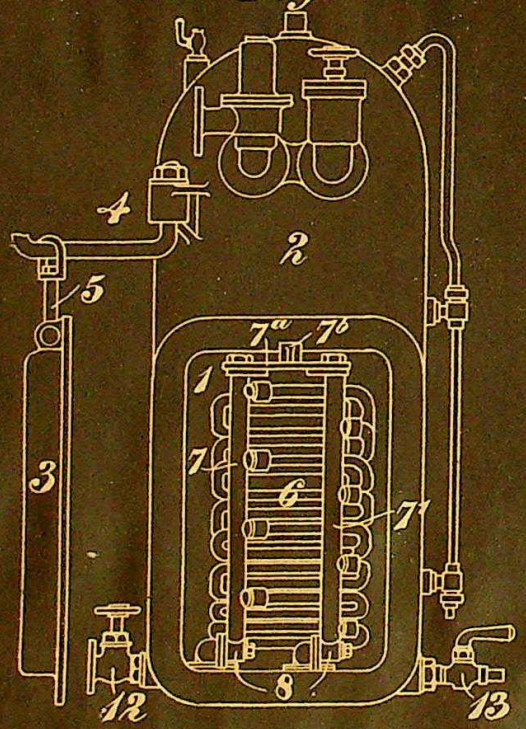

Fig. 10.

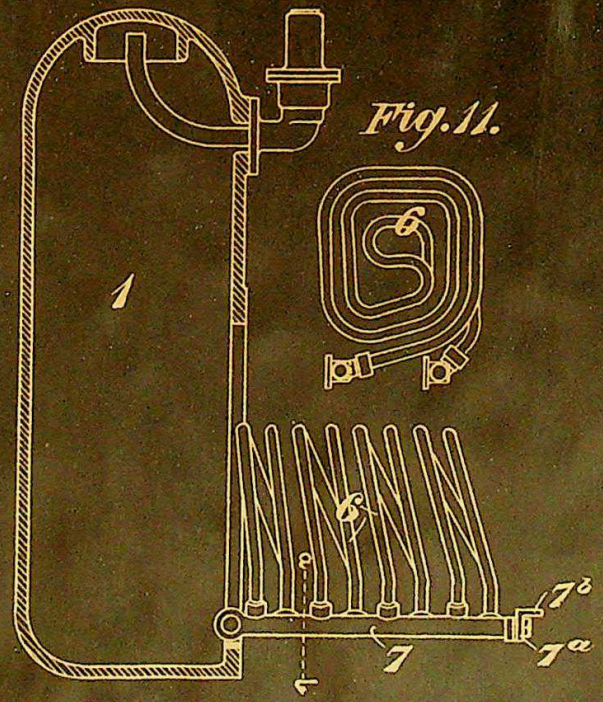

Fig. 11.

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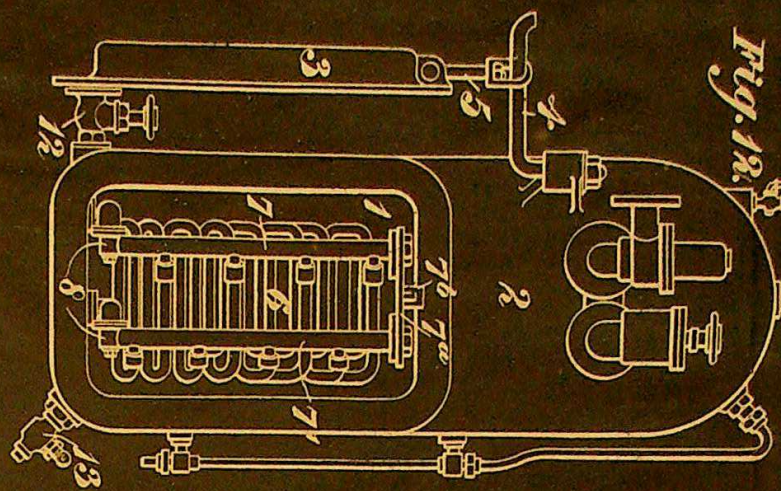

Fig. 12.

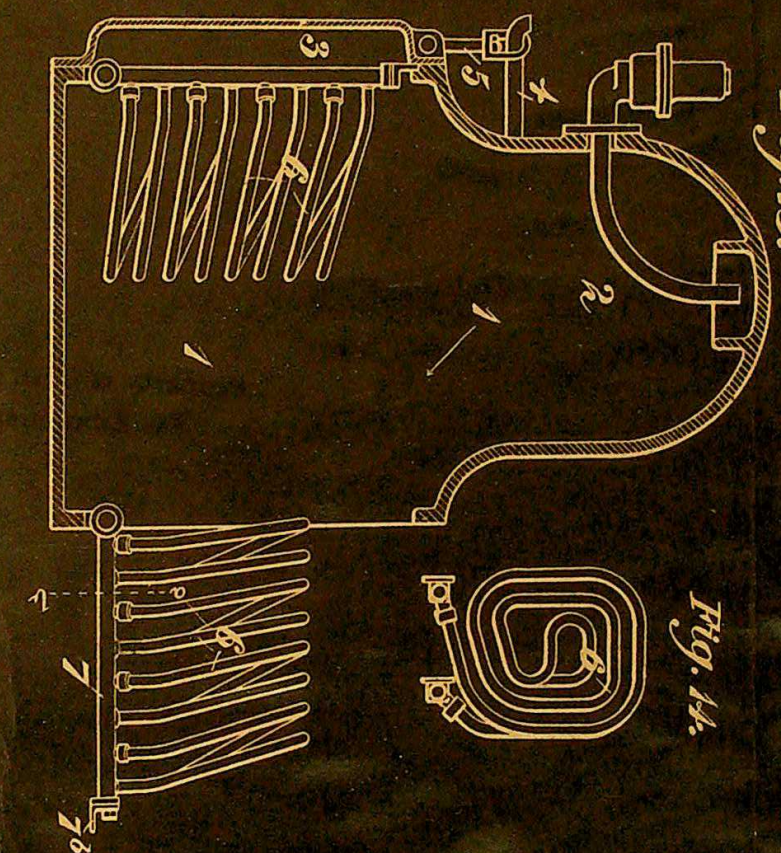

Fig. 13.

Fig. 14.

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Fig. 15.

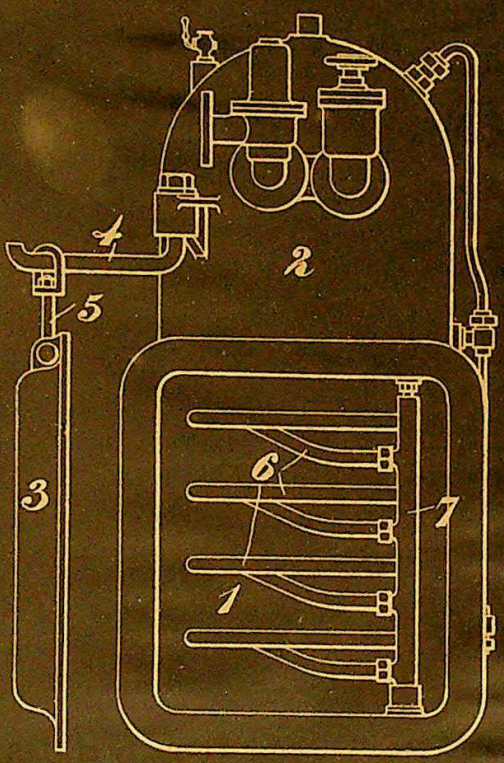


Fig. 16.

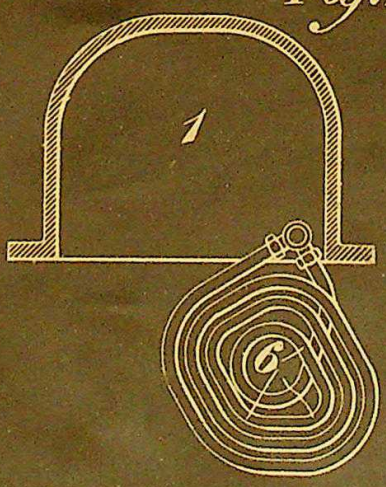
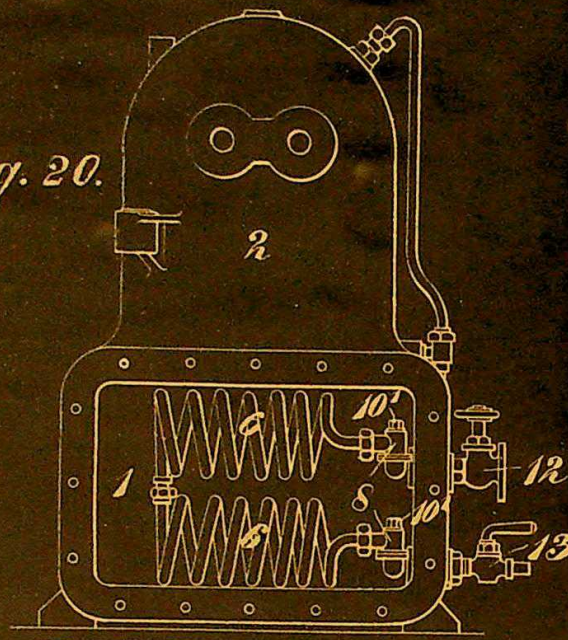


Fig. 20.



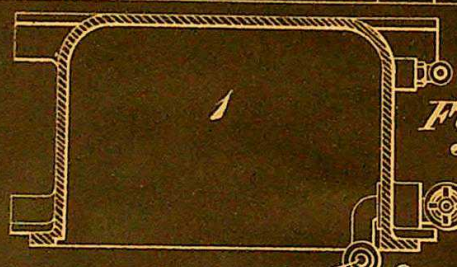


Fig. 21.

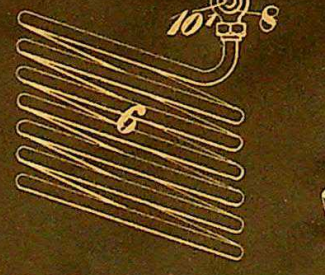


Fig. 22.

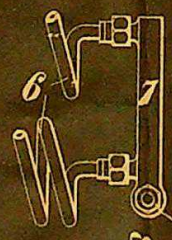


Fig. 23.

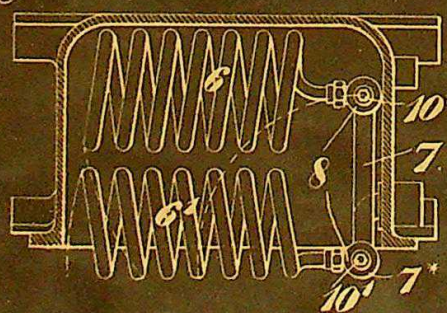


Fig. 27

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Fig. 26.

Fig. 24.

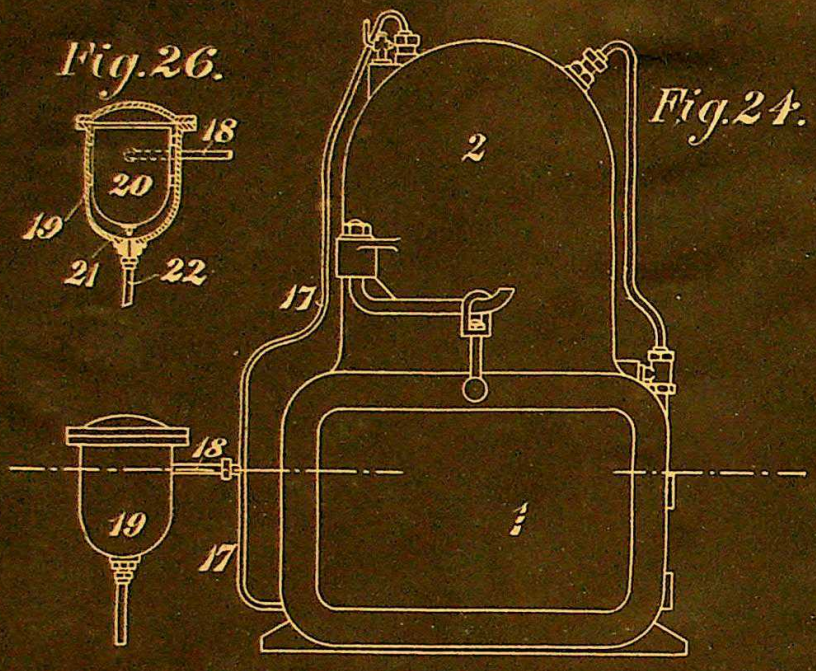
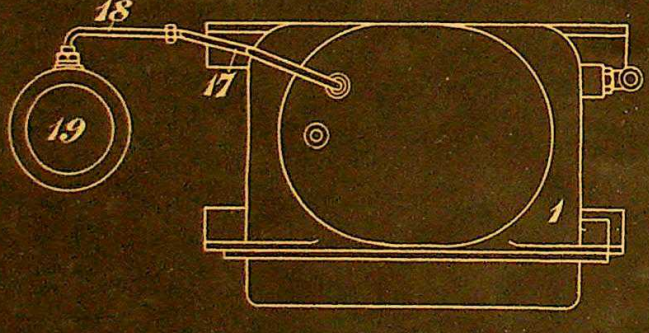


Fig. 25.



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COMPLETE SPECIFICATION.

Improvements in and relating to Apparatus for Heating or Evaporating Liquids by Means of Steam.

I, DONALD BARNS MORISON, of the Hartlepool Engine Works, Hartlepool, in the County of Durham, Engineer, do hereby declare the nature of this invention and in what manner the same is to be performed to be particularly described and ascertained in and by the following statement:—

My invention of improvements in and relating to apparatus for heating or evaporating liquids by means of steam, has reference to an improved arrangement of the heating coils in such apparatus whereby such coils can be readily withdrawn from the evaporating vessel for cleaning, or other purposes, and also to improved means for regulating the discharge of liquid from said vessel so as to prevent it rising above a predetermined level.

To enable the heating coils to be readily removed, they are according to this invention, connected to one or more tubes constituting the inlet passage or passages for the heating steam and the outlet passage or passages for the resulting water of condensation, and such tube or tubes is or are connected to a hollow plug or plugs in such a manner that on the door with which the vessel is provided for obtaining access to its interior being removed, the tube or tubes on which the coils are mounted can be revolved on the hollow plug or plugs as a centre until the coils are moved outside the vessel and into a position affording facilities for examination and cleaning. When one tube and one plug are employed the tube and plug are divided so as to constitute the inlet and outlet passages. When two tubes are employed one forming the inlet to the coils and the other the outlet therefrom, the tubes may be arranged outside the coils, and the coils be arranged in pairs, one coil of each pair being connected to the inlet tube and the other coil of the pair being connected to the outlet tube, thus allowing the coils freedom of movement and at the same time affording facilities for connecting them to the tubes.

The vessel containing the heating coils and the liquid to be heated or evaporated, and which is provided with the usual fittings, may be constructed in various forms.

The accompanying drawings show my invention applied to various arrangements of apparatus suitable for evaporating salt or impure water by means of steam.

Fig. 1 is a front elevation of one arrangement of such apparatus with the door removed and the heating coils connected to two tubes one being the inlet tube and the other the outlet tube each tube terminating in a cap which fits on a hollow plug.

Fig. 2 is a sectional plan of the same with the coils withdrawn from the vessel the tubes having been turned on the inlet and outlet plugs and brought into a position for cleaning or removal.

Fig. 3 is a cross section on the line *a b* of Fig. 2 of the tubes and coils when lifted from off the hollow plugs.

Fig. 4 is a vertical section; and

Fig. 5 a sectional plan, to a larger scale showing a form of hollow cap and plug hereinafter referred to.

The evaporating vessel in this arrangement comprises a lower horizontally arranged water vessel 1 provided with a vertical cylindrical extension 2 having a spherical top and forming a steam dome. The vessel 1 is fitted with a removable door 3 which can be swung by a pivoted arm or bracket 4, to which it is attached by a link 5, into such a position as will enable the heating coils 6 to be readily withdrawn from the said cylinder 1. The heating coils 6, in this example are shown arranged vertically in pairs, and are detachably connected to two horizontal tubes 7, 7^1 that form respectively the inlet for the heating steam employed and the outlet for the resulting water of condensation. Each of these tubes is closed at

its free end, and terminates at the other end in a cap 8 mounted on a hollow plug 9 as shown in Figs. 4 and 5, so that the tubes and connected coils can, when desired, be readily turned on the plugs, from the inward position shown in Fig. 1 to the outward position shown in Fig. 2, the arrangement being practically similar in working to an ordinary cock or tap and thus renders it unnecessary to break and remake the joint or connection between the coils and the steam supply pipe or passage, or between the coils and the water outlet pipe or passage, as has heretofore been necessary. Each plug is attached to the vessel 1, and may be either conical, or parallel, and may be arranged in various well known ways. In the arrangement shown in Figs. 4 and 5, the upper end of the plug is provided with a screw threaded stem 10 fitted with a nut 10^1 so that on the cap being placed on the plug, the requisite pressure for making it steam tight can be obtained by tightening the said nut, in the usual manner, and upon removing the said nuts, the tubes and coils are capable of being lifted off the plugs, and if desired, replaced by a clean set of tubes and coils. In each plug, and in the cap therefor, are corresponding ports or passages 11 and 11^1 respectively, so that when the coils are moved into the vessel, there is a free passage for steam or water between the hollow plugs and the tubes 7, 7^1, and connecting coils 6. 12 (Figs. 1 and 2) is a steam valve for controlling the flow of steam to the upper plug 9 and tube 7, and 13 is a cock for controlling the discharge from the lower tube 7^1 and corresponding plug 9. The free ends of the tubes 7, 7^1 may, as shown in Figs. 1 and 2, be connected by a plate 7^a provided with a bent projecting portion 7^b which, by entering a recess in 7^c in the vessel 1, serves to limit the inward movement of the tubes and coils, the door 3 when secured in place, serving by holding the projecting portion 7^b in the recess, to hold the tubes and coils in position.

In the modified arrangement shown in Figs. 6, 7 and 8 which are similar views to Figs. 1, 2 and 3 respectively, the tubes 7 and 7^1 are of such length and so arranged that two pairs of them can be used, the two pairs of hollow plugs used in this case being at opposite ends of the cylinder or vessel 1 as shown. In this arrangement steam enters through the valve 12 and is thence divided into two portions, one portion entering the hollow plug 9 and tube 7 on the right hand side of the apparatus, and the other portion being conveyed by means of any suitable passage 14 which is shown as being cast in or on the cylinder 1, to the left hand side of the apparatus, and entering the corresponding hollow plug and tube 7 on that side. In a similar manner, the water of condensation is discharged through a passage corresponding with 14, on the lower left hand side of the apparatus, and from thence is discharged through the cock 13 together with the water of condensation from the right hand set of coils and pipes. Instead of a passage 14 there may be suitable pipes arranged on the outside of the apparatus for the same purpose, or, there may be two steam inlet valves 12 with corresponding outlet cocks 13, one for each set of tubes and coils. The tubes and coils may be arranged in various positions as shown in the plan Fig. 7, the object being to obtain a maximum amount of heating surface on the coils for a given size of evaporating vessel 1, and at the same time enable each of the two sets of coils to be removed from the apparatus. This arrangement is suitable for evaporators of large capacity.

In the modified construction shown in Figs. 9, 10 and 11, which are also corresponding views to Figs. 1, 2 and 3 respectively, the evaporating vessel 1 is of vertical tubular form, and the heating coils 6 are connected to vertical tubes 7 7^1 which are arranged to withdraw outward and downward as shown in Fig. 10 instead of outward and sideways as in the previous arrangements.

Figs. 12, 13 and 14 illustrate an arrangement in which there are two sets of tubes and coils each arranged like the single set shown in Figs. 9 and 10, the casing of the evaporator in this case being provided with two doors. In this arrangement the steam may be taken from the right hand portion of the apparatus to the left hand portion, or *vice versa* by means of a passage cast in or on the vessel 1, or by means of suitable pipes arranged on the outside of the said vessel;

or there may be two steam inlet valves 12 with corresponding outlet cocks 13, as described with reference to Figs. 6 and 7.

Figs. 15 and 16 show an arrangement of the apparatus in which the heating coils 6 are connected to a single vertical tube or tubular support 7 that is provided internally with a central dividing rib 7^2 and is mounted on a hollow plug 9, also provided with a central division rib 9^1, as shown more clearly, and to a larger scale, in the detail views Figs. 17 and 18. The plug is formed with ports or openings 11, 11^1 which, when the coils 6 are within the vessel 1, correspond with similar ports or openings 11^1, 11^1 in the lower end of the said tube 7, which is adapted to fit over the plug as shown. The heating steam enters the said plug 9 through one or other of the branches 12^1 or 13^1, and the steam, after passing through the heating coils and becoming condensed therein, is discharged as water of condensation through the opposite branch 13^1 or 12^1, as the case may be. The upper end of the tube 7 may be held in place by any suitable means such for example as a pivot screw 15 (Fig. 19) that enters a fixed part 1^a of the casing and is provided with an adjusting nut 16 by which the said tubular support can be tightened as desired upon the plug 9 to insure a fluid tight joint therewith.

Figs. 20 and 21 are similar views to Figs. 1 and 2 respectively, showing another arrangement in which the coils 6 are connected to short tubular supports on the caps 8. In the example shown, two spiral coils 6 only are shown, connected in series. Where it is desired to use more than two coils, some of them may be connected at one end to a tube 7 as shown in plan Fig. 22, the other ends of the said coils being connected in series with other coils that are connected in like manner to another tube similar to and arranged below the tube 7. Or, as shown in Fig. 23, one of the coils 6 may be jointed to a hollow plug on a tube 7 which in turn may be jointed to a hollow plug at 7^* to which another coil 6^1 is also jointed.

Fig. 27 is a side view of the tube 7 with jointed caps 8 and plug 9 suitable for supporting the coils 6 6^1 in the manner described. The other ends of the coils 6, 6^1 are connected in series to other coils similarly arranged. In withdrawing the coils by this arrangement, the coils 6^1 are first turned on the hollow plugs 9^2, the coils 6 are then turned first on the hollow plugs 9^3 as a centre and then on 9^2 as a centre until they are without the vessel.

The tubes or their equivalent constituting the heating surface may be of any section or shape and in some cases a single heating coil or pair of coils only may be used mounted in either of the ways hereinbefore described.

In the various illustrations the evaporating vessel is shown as being made of cast metal. The vessel or any part of it, may however be made of any suitable material, either cast, stamped or rivetted as may be desired. The coils may also be of any desired form and any suitable number of sets thereof may be employed, according to requirements and the size of the heating or evaporating vessel.

As will be obvious, the positions of each of the caps, or sockets and plugs may be reversed, that is to say the cap or socket may be fixed, and the hollow plug may be at one end of the tube in which case the plug would turn in the cap or socket instead of the cap or socket turning on the plug.

In order that the brine within the evaporating vessel shall not rise beyond a predetermined level, special regulating apparatus may be combined with such vessel as shown in Figs 24, 25 and 26 which are respectively a front elevation, a plan, and a sectional detail view. This regulating apparatus comprises a pipe 17 connected at its lower end with the lower part of the vessel where the liquid is densest, and at its upper end with the steam space in the upper part 2 of the evaporating vessel, and at that part of the said pipe 17 corresponding to the maximum level at which it is desired to maintain the salt water in the vessel 1, there is arranged a branch pipe 18 which is connected to a second vessel 19 provided with a float 20 adapted to govern the discharge of such brine as flows through the branch 18. The vessel 19 may be constructed to form part of the evaporator or it may be made separate therefrom as shown. The float 20 may be

arranged to control the exit of surplus salt water in various ways. In the example shown in Fig. 26 an attachment 21 is made at its lower end, which constitutes a valve, which opens or closes on a valve seat below according as it is raised or lowered the arrangement being such that when the water in the evaporator is at the required level, it will permit the float to assume its lowest position and close the valve opening, and that when the water level in the evaporator rises above the predetermined level, there will be a corresponding rise of water in the vessel 19, and the float will consequently be lifted and allow the excess of water to escape through the discharge pipe 22. The arrangement shown allows the float tank to be situated at a distance from and below the working water level in the evaporating vessel. If the float tank forms part of the evaporating vessel or is situated at the water level the branch 18 is not necessary, the tank in this case being interposed in the length of the pipe 17 so that the upper and lower parts thereof will be in communication with the top and bottom respectively of the tank.

Having now particularly described and ascertained the nature of the said invention and in what manner the same is to be performed I declare that what I claim is:—

1. An apparatus for heating or evaporating liquids by means of steam in which the heating coil or coils is or are connected with a steam supply and water outlet branch or branches by a plug and socket joint or joints the arrangement being such that the said coil or coils can be readily turned about the said plug and socket joint or joints into a position out of or within the evaporating vessel without having to break and remake the joint or connection between the coil or coils and the steam supply pipe or passage or between the coil or coils and the water outlet pipe or passage as above set forth.

2. An apparatus for heating or evaporating liquids by means of steam in which the heating coils are connected through a tube or tubes such as 7, 7^1 serving to support the coils and through a plug and socket joint or joints with a pipe or passage for supplying steam and with a pipe or passage for carrying away water of condensation as referred to in the preceding claim.

3. In heating or evaporating apparatus, the combination with the evaporating vessel, of heating coils, one or more tubes to which the said coils are connected and whereby they are supported, and one or more fixed steam inlet and water outlet plugs, sockets or unions to which the said supporting tube or tubes is or are detachably jointed, substantially as hereinbefore described with reference to the several examples illustrated in Figs. 1 to 23 inclusive of the drawings annexed for the purpose specified.

4. The combination with apparatus for heating or evaporating liquids by means of steam, of the improved means for regulating the discharge of liquid from said vessel so as to prevent it rising above a predetermined level therein and comprising a tank in communication with the steam and water spaces of the evaporating vessel and provided with a discharge outlet or outlets controlled by a valve and through which excess of liquid will be discharged substantially as described and shown, or modified as set forth.

Dated this 12th day of February 1894.

For the Applicant,
W. LLOYD WISE,
46, Lincoln's Inn Fields, London, W.C., Chartered Patent Agent.

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